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**Exhibit R-2, RDT&E Budget Item Justification:** PB 2021 Army **Date:** February 2020

<b>Appropriation/Budget Activity</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army / BA 2: Applied Research</i>	<b>R-1 Program Element (Number/Name)</b> PE 0602105A / <i>Materials Technology</i>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
Total Program Element	-	79.432	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	79.432
H7B: <i>Advanced Materials Initiatives (CA)</i>	-	55.000	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	55.000
H84: <i>Materials</i>	-	20.102	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	20.102
XW4: <i>Manufacturing Science</i>	-	4.330	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	4.330

**Note**

In Fiscal Year (FY) 2020, this Program Element (PE) is being realigned with continuity of effort to the following PEs:

- \* 0602141A Lethality Technology
- \* 0602143A Soldier Lethality Technology
- \* 0602144A Ground Technology
- \* 0602145A Next Generation Combat Vehicle Technology

**A. Mission Description and Budget Item Justification**

This PE conducts fundamental research relevant to the soldier focused on new materials, properties and phenomena in four research areas: (1) lightweight materials and hybrid assemblies for enhanced expeditionary operations, (2) materials and mechanisms that mitigate effects from blast and ballistic threats, (3) materials for augmented soldier protection and situational awareness, and (4) multifunctional materials with integrated structure, power storage, communications, sensing, and/or propulsion to provide system level efficiencies. This PE also funds collaborative applied research and integration of government, academic, and industry scientific research to advance innovative capabilities.

This PE sustains Army science and technology efforts supporting the Soldier portfolio.

Work in this PE builds on the materials research transitioned from PE 0601102A (Defense Research Sciences) and 0601104A (University and Industry Research Centers). This work complements and is fully coordinated with PE 0602618A (Ballistics Technology), PE 0602786A (Warfighter Technology), and PE 0603001A (Warfighter Advanced Technology).

The cited work is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

This work is performed by the United States Army Futures Command.

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<b>B. Program Change Summary (\$ in Millions)</b>	<b>FY 2019</b>	<b>FY 2020</b>	<b>FY 2021 Base</b>	<b>FY 2021 OCO</b>	<b>FY 2021 Total</b>
Previous President's Budget	83.586	0.000	0.000	-	0.000
Current President's Budget	79.432	0.000	0.000	-	0.000
Total Adjustments	-4.154	0.000	0.000	-	0.000
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-3.674	-			
• SBIR/STTR Transfer	-0.480	-			

**Congressional Add Details (\$ in Millions, and Includes General Reductions)**

**Project:** H7B: *Advanced Materials Initiatives (CA)*

Congressional Add: *Program Increase - High Performance Composite Materials*

Congressional Add: *Program Increase - High Performance Polymers Research*

Congressional Add: *Program Increase - Highly Durable Advanced Polymers for Lightweight Armor*

Congressional Add: *Program Increase - Materials Research for Affordability, Performance, and Environmental Sustainability*

Congressional Add: *Program Increase - Advanced Materials Processing*

Congressional Add: *Program Increase - Advanced Polymers*

Congressional Add: *FY 2018 NDAA SEC 825 MDAP Cost Overrun*

Congressional Add Subtotals for Project: H7B

Congressional Add Totals for all Projects

	<b>FY 2019</b>	<b>FY 2020</b>
	5.000	-
	19.916	-
	5.000	-
	10.000	-
	10.000	-
	5.000	-
	0.084	-
Congressional Add Subtotals for Project: H7B	55.000	-
Congressional Add Totals for all Projects	55.000	-

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2021 Army										<b>Date:</b> February 2020		
<b>Appropriation/Budget Activity</b> 2040 / 2					<b>R-1 Program Element (Number/Name)</b> PE 0602105A / <i>Materials Technology</i>				<b>Project (Number/Name)</b> H7B / <i>Advanced Materials Initiatives (CA)</i>			
<b>COST (\$ in Millions)</b>	<b>Prior Years</b>	<b>FY 2019</b>	<b>FY 2020</b>	<b>FY 2021 Base</b>	<b>FY 2021 OCO</b>	<b>FY 2021 Total</b>	<b>FY 2022</b>	<b>FY 2023</b>	<b>FY 2024</b>	<b>FY 2025</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
H7B: <i>Advanced Materials Initiatives (CA)</i>	-	55.000	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	55.000

**Note**

Congressional increase.

**A. Mission Description and Budget Item Justification**

Congressional Interest Item funding provided for Advanced Materials Initiatives.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2019</b>	<b>FY 2020</b>
<b>Congressional Add:</b> Program Increase - High Performance Composite Materials	5.000	-
<b>FY 2019 Accomplishments:</b> Program Increase - High Performance Composite Materials		
<b>Congressional Add:</b> Program Increase - High Performance Polymers Research	19.916	-
<b>FY 2019 Accomplishments:</b> Program Increase - High Performance Polymers Research		
<b>Congressional Add:</b> Program Increase - Highly Durable Advanced Polymers for Lightweight Armor	5.000	-
<b>FY 2019 Accomplishments:</b> Program Increase - Highly Durable Advanced Polymers for Lightweight Armor		
<b>Congressional Add:</b> Program Increase - Materials Research for Affordability, Performance, and Environmental Sustainability	10.000	-
<b>FY 2019 Accomplishments:</b> Program Increase - Materials Research for Affordability, Performance, and Environmental Sustainability		
<b>Congressional Add:</b> Program Increase - Advanced Materials Processing	10.000	-
<b>FY 2019 Accomplishments:</b> Program Increase - Advanced Materials Processing		
<b>Congressional Add:</b> Program Increase - Advanced Polymers	5.000	-
<b>FY 2019 Accomplishments:</b> Program Increase - Advanced Polymers		
<b>Congressional Add:</b> FY 2018 NDAA SEC 825 MDAP Cost Overrun	0.084	-
<b>FY 2019 Accomplishments:</b> FY 2018 NDAA SEC 825 MDAP Cost Overrun		
<b>Congressional Adds Subtotals</b>	55.000	-

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army Date: February 2020

<b>Appropriation/Budget Activity</b> 2040 / 2	<b>R-1 Program Element (Number/Name)</b> PE 0602105A / <i>Materials Technology</i>	<b>Project (Number/Name)</b> H7B / <i>Advanced Materials Initiatives (CA)</i>
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**C. Other Program Funding Summary (\$ in Millions)**

N/A

**Remarks**

**D. Acquisition Strategy**

N/A

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**Exhibit R-2A, RDT&E Project Justification:** PB 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602105A / <i>Materials Technology</i>				Project (Number/Name) H84 / <i>Materials</i>			
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
H84: <i>Materials</i>	-	20.102	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	20.102

**Note**

In Fiscal Year (FY) 2020 this Project is being realigned to:  
 Program Element (PE) 0602141A Lethality Technology  
 \* Project AH8 Lethality Materials and Processes Technology  
 PE 0602143A Soldier Lethality Technology  
 \* Project AZ5 Soldier Protection Technology - Vulnerability  
 \* Project BE6 Reactive/Resp Surfaces & Matls - Soldiers & Sys  
 PE 0602145A Next Generation Combat Vehicle Technology  
 \* Project BI4 Materials Application and Integration Tech

**A. Mission Description and Budget Item Justification**

This Project designs, fabricates, and evaluates a variety of materials (e.g. metals, ceramics, polymers, and composites) that have potential to enable more survivable, lighter weight soldier and vehicle armor, chemical and biological protection, armaments, and electronics. Research conducted focuses on unique and/or novel material properties, developing physics-based models, materials characterization techniques, non-destructive testing methods and advanced fabrication/processing methodologies.

This Project sustains Army science and technology efforts supporting the Ground Maneuver, Lethality, and Soldier portfolios.

Work in this Project makes extensive use of high performance computing and experimental validation and builds on research transitioned from PE 0601102A (Defense Research Sciences), Project H42 (Materials and Mechanics), and Project H43 (Research In Ballistics). The work complements and is fully coordinated with efforts in PE 0602601A (Combat Vehicle and Automotive Technology), PE 0602618A (Ballistic Technology), PE 0602786A (Warfighter Technology), PE 0603001A (Warfighter Advanced Technology), PE 0603004A (Weapons and Munitions Advanced Technology), PE 0603005A (Combat Vehicle and Automotive Advanced Technology), and PE 0708045A (Manufacturing Technology).

The cited work is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2019	FY 2020	FY 2021
<b>Title:</b> Structural Armor Materials	3.899	-	-
<b>Description:</b> Conduct applied research to design and evaluate lightweight armor materials and structures, investigate novel processing methodologies for cost effective manufacturing, use existing and emerging modeling and simulation tools to enable formulation of lightweight, frontal, and structural armor materials for current and future platform applications. Explore ground			

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<b>Appropriation/Budget Activity</b> 2040 / 2		<b>R-1 Program Element (Number/Name)</b> PE 0602105A / <i>Materials Technology</i>		<b>Project (Number/Name)</b> H84 / <i>Materials</i>
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2019</b>	<b>FY 2020</b>	<b>FY 2021</b>
vehicle structural mechanics and dynamics technologies to improve damage tolerance, durability, fatigue-resistance, and dynamic response (shock, vibration, harshness, and damping).				
<b>Title:</b> Soldier-Borne Armor Materials <b>Description:</b> Utilizing understanding of defeat mechanisms from PE 0602618A (Ballistics Technology) / Project H80 (Survivability and Lethality Technology) conduct applied research of emerging lightweight armor materials and structures to enable affordable design of multifunctional ballistic protective systems for the future Soldier. Provide quantitative scientific basis for modeling and simulation that result in materials that utilize new lethal mechanisms/protection schemes for the individual Warfighter.		4.842	-	-
<b>Title:</b> Lethality Materials Technology <b>Description:</b> This effort involves applied research to develop innovative materials solutions aimed at achieving leap-ahead increases in lethality and weapons effectiveness through dramatic improvements in weight and volume efficiency, lethal effects, and sustainability of military systems that can only be achieved through advances in materials technology.		3.764	-	-
<b>Title:</b> Multifunctional Armor Materials <b>Description:</b> This effort researches novel multifunctional armor materials and associated processing science aimed at enabling critical Army applications in survivability and sustainment. Research efforts include multifunctional protective films and coatings, joining of dissimilar materials, and additive manufacturing of multifunctional materials. Soldier personnel protection materials transition to PE 0602786A (Warfighter Technology) / Project H98 (Clothing and Equipment Technology). Vehicle armor materials transition to PE 0602618A (Ballistics Technology) / Project H80 (Survivability and Lethality Technology) and PE 0602601A (Combat Vehicle and Automotive Technology) / Project C05 (Armor Applied Research).		2.415	-	-
<b>Title:</b> Nanomaterials <b>Description:</b> Mature and scale-up nanomaterials processes, fabrication, characterization and performance measures to enable revolutionary concepts for future force lethality and survivability beyond those addressed for individual Soldier protection in PE 0602105A (Materials Technology) / Project H7G (Nanomaterials Applied Research).		2.018	-	-
<b>Title:</b> Bio-enabled Materials and Processes <b>Description:</b> Fundamental research through the application of biotechnology advances to develop materials with capabilities to respond and adapt to a wide range of external stimuli and biological processes.		3.133	-	-
<b>Title:</b> FY 2018 NDAA SEC 825 MDAP Cost Overrun <b>Description:</b> FY 2018 NDAA SEC 825 MDAP Cost Overrun		0.031	-	-

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<b>Appropriation/Budget Activity</b> 2040 / 2	<b>R-1 Program Element (Number/Name)</b> PE 0602105A / <i>Materials Technology</i>	<b>Project (Number/Name)</b> H84 / <i>Materials</i>
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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2019</b>	<b>FY 2020</b>	<b>FY 2021</b>
<b>Accomplishments/Planned Programs Subtotals</b>	20.102	-	-

**C. Other Program Funding Summary (\$ in Millions)**

N/A

**Remarks**

**D. Acquisition Strategy**

N/A

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2021 Army										<b>Date:</b> February 2020		
<b>Appropriation/Budget Activity</b> 2040 / 2					<b>R-1 Program Element (Number/Name)</b> PE 0602105A / <i>Materials Technology</i>				<b>Project (Number/Name)</b> XW4 / <i>Manufacturing Science</i>			
<b>COST (\$ in Millions)</b>	<b>Prior Years</b>	<b>FY 2019</b>	<b>FY 2020</b>	<b>FY 2021 Base</b>	<b>FY 2021 OCO</b>	<b>FY 2021 Total</b>	<b>FY 2022</b>	<b>FY 2023</b>	<b>FY 2024</b>	<b>FY 2025</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
XW4: <i>Manufacturing Science</i>	-	4.330	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	4.330

**Note**

In Fiscal Year (FY) 2020 this Project is being realigned to:  
 Program Element (PE) 0602144A Ground Technology  
 \* Project BL1 Materials and Manufacturing Research Technology

**A. Mission Description and Budget Item Justification**

This Project links materials research, manufacturing processes, and design to enable rapid development and certification of lightweight, multifunctional materials technologies for protection, maneuver, and situational awareness. Research conducted enables new manufacturing capabilities through the development of high performance feedstock materials (polymers, metals, and ceramics), physics-based process models, and in situ process monitoring that can be integrated with process models to enable real-time control and manipulation of materials structure and properties. The goal of this work is to develop robust predictive model and simulation tools linking manufacturing processes with materials structure, properties, and performance to accelerate the rate of innovative material adaptations (protection, power, sensing, and signature management) necessary to rapidly respond to emerging and unknown threats in a battlefield environment.

This Project sustains Army science and technology efforts supporting the Ground Maneuver, Lethality, and Soldier portfolios.

Work in this Project makes extensive use of high performance computing and experimental validation and builds on research transitioned from PE 0601102A (Defense Research Sciences) / Project H42 (Materials and Mechanics), and Project H43 (Research In Ballistics). The work complements and is fully coordinated with efforts in PE 0602105A (Materials Technology), PE 0602601A (Combat Vehicle and Automotive Technology), PE 0602618A (Survivability and Lethality Technologies), PE 0602786A (Warfighter Technology), PE 0603001A (Warfighter Advanced Technology), PE 0603004A (Weapons and Munitions Advanced Technology), PE 0603005A (Combat Vehicle Advanced Technology), and PE 0708045A (Manufacturing Technology).

The cited work is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2019</b>	<b>FY 2020</b>	<b>FY 2021</b>
<b>Title:</b> Agile Expedient Manufacturing	4.323	-	-
<b>Description:</b> Conduct applied research to develop innovative materials technologies that enable new protection, power, sensing, and signature management capabilities utilizing additive manufacturing and related methods to rapidly respond to emerging and unknown threats in a battlefield environment. Efforts include the development of new feedstock materials, engineered specifically for low-volume additive processes to produce net-shape materials with desired properties and functionalities, new processing capabilities that revolutionize additive manufacturing and enable production of lightweight materials systems for protection and maneuverability that cannot be produced through traditional manufacturing methods, integrated process models and real-time			

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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	FY 2019	FY 2020	FY 2021
monitoring for closed-loop control and optimal production of lightweight materials, and abilities to design and produce optimal materials at the point of need using available materials, energy sources, etc.			
<b>Title:</b> FY 2018 NDAA SEC 825 MDAP Cost Overrun <b>Description:</b> FY 2018 NDAA SEC 825 MDAP Cost Overrun	0.007	-	-
<b>Accomplishments/Planned Programs Subtotals</b>	4.330	-	-

**C. Other Program Funding Summary (\$ in Millions)**

N/A

**Remarks**

**D. Acquisition Strategy**

N/A